
Summaries

UDC 621.039.5

Vurim A.D., Shamanin I.V., Vityuk V.A., Gaidaichuk V.A., Aleinikov Yu.V., Zhotabaev Zh.R.

THE TECHNIQUE OF DETERMINING SPATIAL POSITION OF EXPERIMENTAL DEVICES IN CENTRAL EXPERIMENTAL CHANNEL OF PULSE NUCLEAR REACTOR IGR

The possibility of using small-sized fission chambers for determining spatial position in central experimental channel of pulse uranium-graphite reactor of finite bodies made of materials absorbing neutrons has been studied. The results of the experiments on measuring neutron field characteristics in central experimental reactor channel, arranging model irradiated devices in it, were introduced. The description of processing algorithm of neutron current tracers (small-sized fission chambers) allowing determining the position of absorbent relative to a certain detector was given. Analytic dependence for the error of measuring position was determined.

UDC 621.039.517.5

Prozorova I.V., Chertkov Yu.B., Suraev A.S.
USING CERMET FUEL ELEMENTS WITH LOW-ENRICHED FUEL IN THE REACTOR IVG.1M

The results of estimating neutronic parameters of active zone of the reactor IVG.1M have been introduced. They were obtained within the frames of the reactor transition to low-enriched fuel. The conclusion was drawn that cermet fuel elements on the basis of micro-fuel with ^{235}U enrichment not higher than 20 % may serve as a new fuel. The diagrams and estimated parameters of the modified reactor were introduced.

UDC 536.24

Kuznetsov G.V., Al-Ani M.A., Sheremet M.A.
MODES OF MIXED CONVECTION IN TWO-PHASE CLOSED THERMOSYPHON OF CYLINDRICAL FORM

Numerical analysis of thermal conditions of two-phase closed thermosyphon of cylindrical form at mixed convection has been carried out on the assumption of infinite thin evaporation area and liquid film of constant thickness. Mathematical model stated in nondimensional variables «stream function – vorticity – temperature» was numerically implemented on the basis of finite-difference method. Distributions of stream-lines, temperature and velocity field characterizing formation and development of thermo-hydrodynamic structures in the analyzed object were obtained.

UDC 53.082.2:550.3

Babushkin I.A., Demin V.A., Pepelyaev D.V.
NUMERICAL MODELING OF CONVECTIVE DETECTOR OPERATION AT CENTRIFUGAL EFFECT

The numerical modeling of convective detector response of inertia acceleration to centrifugal effect has been carried out. The main stream in the form of pulsing convective tail and its crisis at certain rotation frequency was described. It was shown that continuous variation of centrifugal force magnitude allows inclining gradually the convective tail in the plane of cavity wide edges. Optimal arrangement of thermocouples in detector working chamber subject to the pres-

ence of complicating factors connected to certain irregularity of experimental device was determined by centrifugal effect.

UDC 519.63

Zimin V.P.
IMAGE AND ANALYSIS OF BOUNDARY CONDITIONS FOR HEAT CONDUCTION EQUATION ON PHASE PLANES

New method of imaging and analyzing boundary conditions of heat conduction boundary problem on temperature phase planes – temperature gradient and temperature – heat flux density has been proposed. The features of all types (kinds) of linear boundary conditions on these planes were analyzed. The behavior of non-linear boundary conditions on phase planes for two problems was studied. The experimental and model results of electron temperature distribution problem in low-temperature plasma of thermionic converter were compared.

UDC 621.311.22:621.182

Finichenko A.Yu.
THE TECHNIQUE OF RATIONING HEAT CONSUMPTION IN STATIONARY PRODUCTION AT RAILWAY TRANSPORT

The issue of rationing thermal energy in stationary heat engineering of railway transport has been considered; its task is to develop the rates of thermal energy consumption for certain process steps and manufacturing processes. Mathematical model of determining heat consumption in laundries, disinfection chambers and for uniform clean in organization departments of «Russian Railways» was defined. It is intended to help the employees reliable for utilities of linear railway enterprises in determining standard rates of thermal energy for certain processing procedures.

UDC 620.165.29:620.176.16

Stepanchenko T.E., Shklyar V.N.
ESTIMATING ACCURACY OF ALGORITHM FOR DETERMINING LOSS PARAMETERS

The influence of sensitivity of pressure sensors installed at pipeline and change of parameters of pipeline and transported liquid on accuracy of determining coordinate and mass rate of loss in the pipelines has been studied by the algorithms on the basis of hydrodynamic models. It was shown that variation of transported liquid density and its rate influences most of all on accuracy of determining loss parameters.

UDC 66.048:533.15

Feoktistov D.V.
APPROXIMATE ANALYTICAL SOLUTION OF THE PROBLEM OF VAPOR PHASE LIGHT-VOLATILE COMPONENT DIFFUSION IN A SIMPLE DISTILLATION DEVICE

The approximate analytical solution of the problem of vapor phase light-volatile component diffusion in a simple distillation device has been obtained. The applicability boundaries of the obtained solution were determined. The problem of concentration distribution in vapor phase of light-volatile component from phase boundary to a branch pipe carrying off distillate vapors, was solved by the example of distiller apparatus.

UDC 621.181.12

**Lyubimova L.L., Makeev A.A., Zavorin A.S.,
Tashlykov A.A., Fisenko R.N.**

**THE LEVEL OF INTERNAL STRUCTURAL STRESSES AS
AN INDEX OF AVAILABILITY OF LONG-TERM OPERATED
SUPER-HEATER**

The possibility of testing steam boiler heating surface has been substantiated on the basis of internal structural stress analysis. The current physical state of heating surface worked out economic life was determined on the basis of the experimental data defining material capacitance to nondestructive deformation. Strength margin was estimated; the criterion reflecting strength margin of steam line metal in respect to operation conditions was determined. The references for extended life of the metal worked out the designed resource were formulated on the basis of strength margin estimated values.

UDC 662.64

**Kazakova O.A., Zavorin A.S., Kazakov A.V.
COMPOSITION OF COAL INORGANIC PART
OF TALOVSKOE DEPOSIT IN TOMSK REGION**

The results of the laboratory researches of brown coal mineral part of Talovskoe deposit in Tomsk region have been introduced. They include ash chemical composition and data on powdered coal distribution into fractions of different density. Ash content and fraction destitution was shown. The main groups of components were qualitatively determined and they were quantitatively estimated. The conclusion was drawn on composition and structure of coal mineral part required for designing fuel-burning devices.

UDC 669.181.42

**Arkipov V.S., Baskakova N.A.
THE INFLUENCE OF PEAT-ORE MATERIAL COMPOSITION
ON METALLIZATION PROCESS AND QUALITY
OF METALLIZED PRODUCT OF BAKCHAR IRON ORE**

Recovery of peat-ore materials made on the basis of iron ore of Bakchar deposit of Tomsk region and Vasyugan deposit peat has been studied. Four types of peat at content of 10, 20, and 30 % of peat per dry peat-ore mass were tested. The recovery was carried out in the mode of linear heating at the rate of 5 °C per minute to the finite temperatures 500...1100 °C at interval of 100 °C. Metalized product with metallization degree from 30 to 80 % at 1100 °C was obtained. It was ascertained that the recovery rate and metallization degree are determined by peat content. Peat type does not influence considerably on recovery process rate.

UDC 621.317.727.1

**Roitman M.S.
PRECISION VOLTAGE DIVIDERS (STATE AND TASKS)**

The approaches to construction of precision dividers of constant and alternating voltages have been represented. It is noticed that the combined dividers are worth of special attention. They contain multi-decade inductive dividers which are necessary for correcting the whole system and in perspective – dividers on matrices of Josephson junctions and cryoelectronic ones.

UDC 681.2.08

**Zlygosteva G.V., Muraviev S.V.
THE GENERALIZED MODEL OF TESTING PROCEDURE
OF MEASUREMENT SOFTWARE**

The generalized model of testing procedure of measurement software has been proposed. The types of procedures: software testing at approval of measuring device type, validation and certification were found out. Each type of procedure was systematically described according to the elements of the proposed generalized model.

UDC 004.9+543.08

**Muraviev S.V., Gavrilenko N.A.,
Silushkin S.V., Ovchinnikov P.G.
MOBILE COLORIMETRIC COMPLEX FOR MEASURING SUB-
STANCE COMPOSITION ON THE BASIS OF POLYMERIC
OPTODES**

The possibility of constructing compact portable hardware-software complex on the basis of the method of quantitative digital color analysis has been discussed. Transparent optodes were used for the method implementation. It supports the increase of sensitivity in the field of small optical densities in 1–2 orders. The structural diagram of analyzer instrument part and solutions on implementation of its software were proposed.

UDC 537.1:537.3

**Nosov G.V., Kuleshova E.O.
THE ADVANCED METHOD OF THE EQUIVALENT
GENERATOR AT DIRECT CURRENT**

The advanced method of the equivalent generator allowing determining current in the load and power in the initial chain has been introduced. The equivalent circuit of active two-pole by the equivalent generator was proposed and the design formulas of determining its parameters were introduced.

UDC 621.3.062.8

**Pustynnikov S.V., Khokhlova T.E.
THE MODELING OF RESONANT SWITCH IN DC CIRCUIT**

A model of a resonant switch in the high-current DC circuit has been studied. It allows switching off an inductive load by contactless way using series circuit resonance. The expression for calculating resonant capacitance was obtained. The method of state variables for calculating the transient process was used in the mathematical model. It allows calculating current in the load circuit in terms of resonant switch parameters. The calculation results were proved by the computer simulation.

UDC 621.373.13

**Rybin Yu.K.
THE ANALYSIS OF GENERATOR OSCILLATION SYSTEMS
OF ELECTRIC SIGNALS ON NEW OPERATING AMPLIFIERS**

Generator oscillation systems of electric sinusoidal signals on new amplifiers have been analyzed. The latter got the name CFOA – current feedback operational amplifier in foreign literature. It was shown that such system analysis based on linear models of amplifiers does not allow estimating correctly the advantages and disadvantages of the systems implemented on these amplifiers. The investigation of the systems, subject to the proposed non-linear model of current feedback amplifier, showed that application of the new amplifiers do not give considerable advantages almost in all oscillation parameters.

UDC 621.317.727.1

**Kim V.L.
ESTIMATION OF SURGE IN INDUCTIVE
VOLTAGE DIVIDER WITH BALANCE WINDING**

The generalized description of transfer function of the decade inductive voltage divider with balance winding has been proposed. The conditions of minimizing dynamic error and surge were stated. The results of the divider experimental researches were introduced.

UDC 621.396.969.18

**Mironov M.V., Voroshilin E.P., Mescheryakov A.A.
EXPERIMENTAL TEST OF APPROXIMATION ALGORITHM OF
ANTENNA SYSTEM DIRECTION PATTERN**

The approximation method of antenna pattern of multi-beam antenna system used for amplitude bearing of ground radiation

sources has been proposed. Mathematical modeling of approximation algorithm was carried out; several approximation algorithms were compared and experimental test of the proposed algorithm at approximation of antenna pattern of three-beam parabolic antenna was carried out.

UDC 621.314

Volkov I.V., Zozulev V.I., Kalyuzhnyi A.A., Sholokh D.A.
SEMICONDUCTOR-MAGNETIC GENERATORS
OF NANO-SECOND PULSES: PROBLEM STATE,
GENERAL METHODS OF IMPROVING EFFICIENCY

The main issues and problems which are not covered or not covered enough in articles on the considered subject have been introduced. The methods of improving the efficiency of semiconductor-magnetic generators were proposed subject to the accepted restrictions, assumptions and conditions. It was shown that implementation of these methods is mainly fulfilled owing to increase of pulse compression coefficient, application of different-functional nodes and support of gentle operation modes to semiconductor switches.

UDC 621.314

Volkov I.V., Zozulev V.I., Kalyuzhnyi A.A., Sholokh D.A.
SEMICONDUCTOR-MAGNETIC GENERATORS
OF NANO-SECOND PULSES WITH ENHANCED
OPPORTUNITIES OF THEIR APPLICATION

The main results of investigations of three groups of semiconductor-magnetic generators: single-contact unipolar ones, double-contact unipolar and bipolar ones have been introduced. It was shown that the main problems of advanced opportunities of their applications are efficiently solved by these three groups of generators. Adequacy with generators on the basis of ion switches estimated by output load parameters; high reliability; extended and new functions; commensurable and better other indices were achieved.

UDC 621.791

Knyazkov A.F., Birukova O.S.
THE DEVICE FOR WELDING
IN ARC DYNAMIC BURNING MODE

The process of forming arc current pulses supporting arc steady-state burning in dynamic mode has been considered. The device with forming element made on the basis of artificial forming line was developed. The researches were carried out at welding with nonconsumable electrode in argon medium. The advantages of weld joint at arc welding burning in dynamic mode were shown.

UDC 620.97

Savrasov V.F., Savrasov F.V., Yurchenko A.V., Yurchenko V.I.
THE ANALYSIS OF USING SOLAR ENERGY
IN TOMSK REGION

Annual monitoring of joint action of solar-wind power plant has been carried out and optimal parameters of their operation in winter season have been determined. Different factors of developing solar power energy in Tomsk region were analyzed by the method of multi-dimensional vectors and high level of scientific-production base and acceptable level of solar-wind resources were shown.

UDC 681.513.1

Lukutin B.V., Shandarova E.B.
PHASE-ADJUSTED AUTO-BALLAST STABILIZATION
SYSTEMS OF MICRO-HPP OUTPUT PARAMETERS

The possibility of stabilizing frequency and value of generated voltage of micro-hydro-electric power station by auto-ballast stabilization systems has been shown. The results of calculations of the value and phase of generator equivalent load for the station with stabilization system constructed on thyristors with natural commutation and fully-adjusted thyristors for active and active-inductive ballast were introduced. It was ascertained that application of auto-ballast systems constructed on transistors or on fully-adjusted thyristors allows supporting more precisely the uniformity of value and charac-

ter of the equivalent resultant load of the station. It allows supporting the uniformity of the value and frequency of generated voltage at station operation on active-inductive ballast of commensurable power.

UDC 621.315.1

Khrushchev Yu.V., Batseva N.L., Abramochkina L.V.
IDENTIFICATION OF LONG-LINE ATTENUATION
PARAMETERS OF LONG-DISTANCE TRANSMISSION LINE
USING RECORDING SYSTEM OF EMERGENCY SIGNALS

Identification algorithms of long-line attenuation parameters of long-distance transmission line of alternating current have been introduced and tested. The algorithms provide for use of initial information in the form of arrays of instantaneous currents and voltages at transmission line ends obtained by recording system of emergency signals. High accuracy of compliance of model long-line attenuation parameters and those determined by the proposed algorithms was obtained.

UDC 621.311.2

Chistyakov G.N., Sigaev S.N.
EXPERIMENTAL INVESTIGATION OF CURRENT
IN TRANSFORMER NEUTRAL AT GEO-MAGNETIC STORM

The main results of statistic data processing on operating irregularities of electrical facilities in power system at «Khakasenergo» have been introduced subject to the data on geo-magnetic field state. The data on the results of experimental researches in the neutral of the transformer TRDN-32000/110, installed in ODS-110 kV of Abakan TPP (TGC-13) were introduced. They were carried out in the time of high geomagnetic activity and in the time of sound state of geomagnetic field. The dependence of equipment failures under the action of geomagnetic field variations at geomagnetic storms was ascertained.

UDC 621.313.333

Aristov A.V.
OSCILLATORY ELECTRIC DRIVE
WITH ADJUSTED NEUTRAL POSITION

Algorithms and functional diagrams of oscillatory electric drives allowing balancing geometric neutral position drift at start and adjustment of oscillation frequency at symmetric and asymmetric load operation have been introduced. The feedback influence on amplitude-frequency characteristics of oscillatory electric drive was estimated by the position with allowance for position load.

UDC 621.313.333.001.5

Baklin V.S., Pushkarev I.I.
OPTIMIZATION ALGORITHM FOR CALCULATIONS
OF HIGH VOLTAGE INDUCTION MOTORS

The algorithm of calculation and search of optimal calculation variant of cage rotor induction motors with stator and rotor slots of rectangular shape has been proposed. The developed algorithm contains minimal amount of modified variables: induction in an air gap, width of standard rectangular conductor slot, a number of efficient conductors in stator slot and the width of rotor slot; it allows decreasing substantially the amount of calculation variants and using the full enumeration method for searching optimal calculation variant satisfying the purpose function.

UDC 621.313.322:537.812

Bogdanov E.P.
MODERNIZATION OF BRUSH-COLLECTOR ASSEMBLY
OF SYNCHRONOUS GENERATOR FOR IMPROVING
ITS ELECTROMAGNETIC COMPATIBILITY

A variant of shielding scatter band of synchronous generator air gap has been introduced. It was shown that the decrease of generator losses and increase of electromagnetic compatibility with radio-electronic systems of different purposes are provided by shielding of magnetic and electric noise fields and their plane waves in frequency range from 0,15 to 1000 MHz as well as by fulfilling a number of rows of separate holes across the width of the brush in the upper part of aliform tides.

UDC 621.3.048.81

**Maryin S.S., Shulikin S.N., Shulikin I.N.
STUDYING DEFECT FORMATION AND INTERNAL
MECHANICAL PRESSURE IN INTERTURN INSULATION
OF LOW-VOLTAGE ELECTRIC MACHINES**

Possible reasons of interturn insulation destruction have been studied using the samples imitating the wind of low-voltage electric machines. The influence of viscosity of impregnating compositions ML-92 and KO-916K on the level of internal mechanical pressure and rate of defect formation in interturn insulation of low-voltage electric machine was ascertained.

UDC 621.3.048.81

**Maryin S.S., Shulikin S.N., Shulikin I.N.
THE METHOD OF ESTIMATING LIFE TIME
OF LOW-VOLTAGE INTERTURN INSULATION**

The dependence of breakdown voltage of interturn insulation on mechanical strength of insulating materials has been determined. It was shown that excessive cracking in interturn insulation is the reason of material loss of its insulation properties. The method of calculation of low-voltage interturn insulation life time was developed on the basis of the theory of solid body strength.

UDC 621.313.4

**Berbirenkov I.A., Lokhnin V.V.
TRACTIVE MOTORS ON PERMANENT MAGNETS
IN ELECTRO-MOBILE ELECTRIC DRIVE**

Tractive electric drives with different types of tractive electric motors (direct current, induction, valve with excitation from perma-

nent magnets) have been analyzed and compared. It was shown that the tractive electric drive with valve motor with excitation from permanent magnets is the most perspective ones. New constructions of rotors of collector and claw-shaped types were proposed for valve motors with excitation from permanent magnets. They provide maximum accessible magnetic flux concentration in working air gap.

UDC 62-523

**Zavjalov V.M., Gusev A.V.
AUTOMATIC LIMITATION OF DYNAMIC LOADS
OF TRAVELLING CRANE LIFT ELECTRIC DRIVE**

The dynamic loads occurring in travelling crane rope at load breaking off the surface have been proposed to be limited using synergic regulator of elastic moment. The conditions required for dynamic stress limitation in the rope at gap selection were determined. The results of computer simulation of load breaking off the surface with automatic limitation of dynamic loads were introduced.

UDC 621(091);621:331.108

**Sovetchenko B.F., Gnyusov S.F.
THE EIGHTIETH ANNIVERSARY OF THE DEPARTMENT
«EQUIPMENT AND TECHNOLOGY OF WELDING
ENGINEERING»**

The history of formation and development of one of the oldest departments of Tomsk polytechnic university «Equipment and technology of welding engineering», establishment of its scientific and educational schools have been described. It was told about the achievements of professors of the department in different years of its existence. The most significant success of the department graduates is introduced.